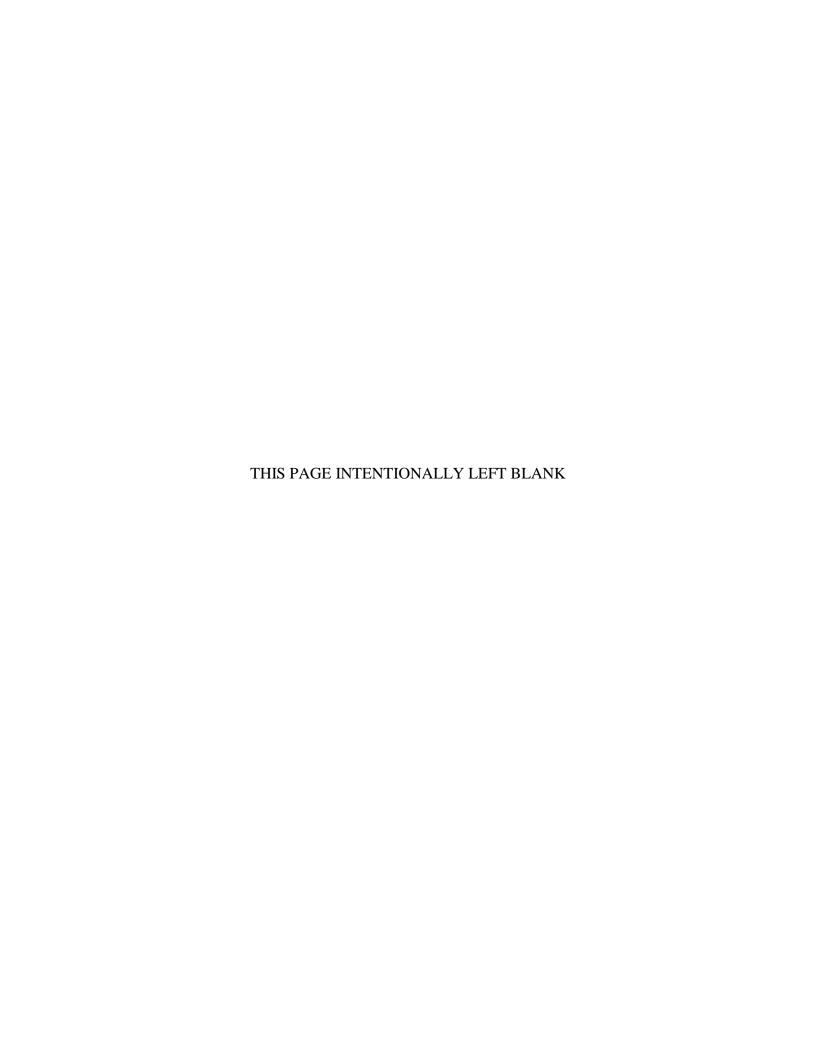# NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

AN ANALYSIS OF THE CAREER PROGRESSION OF HISPANIC MILITARY OFFICERS

Simona Tick, Elda Pema, Stephen Mehay, and Mateo Salas

November, 2015

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14. ABSTRACT

This study assesses the career success of Hispanics in the U.S. military by conducting a comparative analysis of the position and performance of Hispanics across all four service branches. Using Defense Manpower Data Center (DMDC) data on officers commissioned between fiscal years 1999 and 2003, this study applies multivariate statistical techniques to analyze the relative success of Hispanic and non-Hispanic officers on indicators of retention and promotion. The cross-service results show that Hispanic officers have higher early retention rates than White non-Hispanic officers in the Army and Marine Corps, but lower early retention in the Navy. There are few differences in retention to 10 years of service across the military services, and no significant differences in promotion to O-4. The study also examines more detailed information obtained from the Marine Corps and finds that omitting education background and fitness report scores of officers may lead to biased estimates in standard retention and promotion models. Finally, the report recommends that the Navy explores the possible causes of the higher separation rates for junior Hispanic officers.

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EXECUTIVE SUMMARY

The Navy's 21st Century Sailor & Marine Initiative stresses diversity and inclusion with a goal of creating a Department with no barriers to opportunity. The initiative emphasizes the need, in a global operational environment, for a diversity of ideas, experiences, areas of expertise and backgrounds to fulfill the Navy's mission (U.S. Navy, 2013). Maintaining diversity in the armed forces presents numerous challenges to defense decision-makers in terms of reconciling policies governing recruitment, retention, training, career progression, and leadership development.

Perhaps no demographic trend in recent U.S. history has been as dramatic or impactful as the steady growth of the Hispanic population. Between 2000 and 2013, the Hispanic population rose to 54 million (17 percent of the population) and is predicted to reach 128 million by 2060 (31 percent of the population) (U.S. Census Bureau, 2011; 2014). This demographic trend presents opportunities as wells as challenges in meeting future manpower requirements. Although Hispanic males have the highest propensity for military service compared to other ethnic groups, currently they are underrepresented in the military (Office of Undersecretary of Defense, 2014). The underrepresentation of Hispanics in the officer corps presents an ongoing issue in terms of maintaining diversity in the military's leadership ranks. The Military Leadership Diversity Commission (2011) concluded that the military leadership does not represent the public it serves or the forces it leads.

The goal of the study is to assess the career success of Hispanics in the U.S. Navy officer corps in a comparative analysis of the position and performance of Hispanics across the four service branches. The study uses standard indicators of personnel performance and position, including retention at various career points and career success as measured by promotion. Multivariate statistical techniques are used to analyze indicators of officer career success and to compare the relative success of Hispanic and non-Hispanic officers.

The goal of the analysis is to inform decision-makers on potential policies that would enhance diversity in the Navy officer corps by expanding the market for Hispanic

officers and increasing their career success. These policies would have the ultimate objective of enhancing the presence of Hispanics in the leadership grades of the Navy officer corps.

A review of the prior literature on minority officers finds a wide variation in estimates of the effects of ethnic background on retention and promotion. Some of this variation across studies is due to differences in the time period covered by the data in each study, or whether the data are cross-sectional or longitudinal. Some variation also stems from differences in methodology, with some studies analyzing unadjusted continuation and promotion rates, and others deriving adjusted rates based on estimates from multivariate models. Among studies that apply multivariate models, some have relied on single-equation models of retention or promotion, whereas others have used modeling techniques to adjust for self-selection of officers in the voluntary retention decision. There are also differences in how basic retention or continuation rates, as well as promotion rates, are measured. These differences make it difficult to compare studies and thus to draw firm generalizations from the literature.

The data used in this study were provided by the Defense Manpower Data Center (DMDC). The data set captures all officers commissioned between fiscal years (FY) 1999 and 2003. The data capture demographic and service-related characteristics for each individual at commissioning and annually through FY 2013 or until the individual separated from the service.

Table A summarizes the results of the statistical analysis of officer retention at two career points: at expiration of the Minimum Service Requirement (MSR) and at 10 years of service. We also analyze the probability of promotion to grade O–4 among those who complete at least 10 years of service.

As shown in Table A, the results of the probit models for the pooled all-service sample find that, within an entering cohort, Hispanic officers have higher MSR retention rates than White non-Hispanic officers. This effect, however, is not large, representing only a 3 percent difference in retention. Further, there is no significant effect of Hispanic background on 10-year retention and on O-4 promotion. There is some variation, however, in these effects across the individual service branches. For example, compared

to the Army and the Marine Corps, Hispanic officers in the Navy have slightly lower MSR retention than Whites and in the Air Force they have lower 10-year retention. The difference in MSR retention in the Navy is small in magnitude and is significant at the .10 level but not at the higher significance levels (.01 or .05) normally preferred by statisticians.

Table A. Estimated Percentage Point Differences in Career Outcomes for Hispanic Officers

Career Outcomes	All Services (DMDC Data)	Army	Air Force	USMC	Navy	USMC (TFDW Data)
MSR Retention	+2.0	+6.6	N.S.	+7.1	-2.3[a]	+5.9
10 YOS Retention	N.S.	N.S.	-3.8	N.S.	N.S.	+4.7
O-4 Promotion	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Fitness Report Scores	--	--	--	--	--	-1.9
N.S. = Not significant						
[a]Significant at .10 level; all other percentage point differences are significant at either the .01 or .05 level						

Although differences in career outcomes among Hispanics are small or insignificant, differences for women or Blacks are larger and generally statistically significant. For example, we find that women have lower retention rates at both the MSR career point and at the 10-year point and that the magnitude of these retention gaps are relatively large. Also, women are less likely to be promoted to O-4. Black officers have significantly higher retention than Whites at both career milestones but experience lower promotion rates to O-4.

We also provide separate analyses of the career progression of Marine Corps officers based on administrative data from a different source. There are several reasons for doing this. Prior research has found that the pre-commissioning educational

background of officers is associated with job performance. Examples of these background attributes include the quality of the undergraduate institution (college selectivity), undergraduate academic performance (college GPA, order of merit), college major (technical versus non-technical), or aptitude (SAT scores), among others. When these variables are omitted from the performance models the estimated coefficient of the ethnicity indicator will capture the indirect effects of the omitted variables as well as the direct effects of ethnic background.

The DMDC data used to derive the results in Table A did not contain information on educational background. The Marine Corps Total Force Data Warehouse (TFDW), however, provides extensive information on Marine officers including educational background. Our goal in using TFDW data was to assess the effects of variables that are omitted in the all-service models using DMDC data and gauge any potential biases these omissions might create. In addition, we obtained fitness report scores on Marine officers and use them as supplemental performance measures.

The supplemental results for Marine officers based on TFDW data are summarized in the last column of Table A. In both data sets Hispanic Marines have higher MSR retention rates. However, unlike the DMDC data, the TFDW data shows that Hispanics have higher 10-year retention in the Marine Corps. Also, the last row of Table A indicates that Hispanics receive lower cumulative fitness report scores than non-Hispanic officers. Finally, supplemental analyses of the TFDW data finds that fitness report scores positively impact O-4 promotion rates.

The supplemental results suggest that the direct estimated effects of Hispanic background may be biased in models that omit fitness report scores. Because fitness report scores are positively associated with O-4 promotion and Hispanics are observed to have lower cumulative fitness report scores, when these scores are omitted from the promotion models, the estimated effect of Hispanic background will be biased toward zero (i.e., understated). Thus, omitted variable bias may account at least partially for the finding of no promotion effect for Hispanics.

Overall, it appears that career progression of Hispanic officers in the Navy is similar to that of Hispanics in the other military service branches. The sole exceptions are

the lower MSR retention in the Navy and the lower 10-year retention in the Air Force.

This conclusion, however, must be viewed with caution and is subject to several important qualifications. First, we do not model promotion to O-5 or O-6 and thus cannot assess attainment of top leadership positions. Since promotion opportunities are narrower at these higher grades by virtue of DOPMA guidelines, Hispanics could still encounter numerous obstacles to command positions (see Hosek, et al., 2001). In addition, modeling retention and promotion outcomes in single-equation models may not accurately capture career progression patterns of a given demographic group. For example, promotion to O-4 involves potential selection bias because those who stay to the O-4 promotion board are self-selected. Hence, promotion models must account for non-random selection (see Bowman and Mehay, 2002). Also, voluntary retention decisions as well as decisions by promotion boards are affected by job performance, as measured by fitness reports. A more complete analysis of career progression for any group using administrative data requires more extensive and more detailed data as well as multi-equation modeling approaches.

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I.   INTRODUCTION

The Department of Defense (DoD) has recognized the changing population of the nation and has sought to ensure that the military represents the diversity of race, ethnic, and socioeconomic backgrounds in the population. DoD's *Diversity and Inclusion Strategic Plan* views diversity as a strategic imperative*:*

> Diverse backgrounds and experiences bring inherently different outlooks and ways of thinking, the key to innovation in organizations. We gain a strategic advantage by leveraging the diversity of all members and creating an inclusive environment in which each member is valued and encouraged to provide ideas critical to innovation, optimization and organizational mission success. (U.S. Defense Department, 2012)

Similarly, the Navy's *21st Century Sailor & Marine Initiative* stresses diversity and inclusion with a goal of creating a Department with no barriers to opportunity. The initiative emphasizes the need, in a global operational environment, for a diversity of ideas, experiences, areas of expertise, and backgrounds to fulfill the Navy's mission (U.S. Navy, 2013). Maintaining diversity in the armed forces presents numerous challenges to defense decision-makers in terms of reconciling policies governing recruitment, retention, skill development, career progression, and leadership development (Hosek et al., 2001; Lim et al., 2009).

Perhaps no demographic trend in U.S. history has been as dramatic or impactful as the steady growth of the Hispanic population. This growth has presented numerous challenges to defense policy makers. Between 2000 and 2013, the Hispanic population rose from 35 million (13 percent of the total population), to 54 million (17 percent of the population) (U.S. Census Bureau, 2011; 2014). In two of the largest states, California and Texas, Hispanics currently account for nearly 40 percent of the population. The U.S. Census Bureau predicts that the Hispanic population in the U.S. will continue to grow and will reach 128 million by 2060 (31 percent of the population).

These demographic trends have created great interest in the role of Hispanics in meeting the military's future manpower needs. Although Hispanic males have the highest propensity for military service compared to other ethnic groups, they currently are

underrepresented in the military. In terms of active duty military, Hispanics now constitute 12.8 percent of enlistees (compared to 21.2 percent in the civilian youth population) and 5.7 percent of the officer corps (compared to 8.6 percent of civilian college graduates 21 to 35 years old) (Office of Undersecretary of Defense, 2014). The underrepresentation of Hispanics in the officer corps presents an ongoing challenge to DoD policymakers in maintaining diversity in the leadership ranks.

The Military Leadership Diversity Commission (MLDC) concluded that the military leadership does not represent the public it serves or the forces it leads. They argue that two factors contribute to the underrepresentation of minorities and females among officers and senior military leaders: lower rates of promotion for minority males than White male officers and, in the case of mid-level female officers, lower retention rates (Military Leadership Diversity Commission, 2011). It is unknown, however, what the relative contribution of differences in promotion and retention are to low leadership representation and whether other factors also contribute to differences in promotion and retention outcomes.

Planning and managing the development of senior leaders is complicated by the military's closed personnel system. For example, the process of 'growing' one Navy officer to the rank of O-6 starts with his/her entry into a commissioning program, such as NROTC or the U.S. Naval Academy, until eventual promotion to O-6, a process which can take as long as 26 years. Officers who are being promoted to O-6 today (2015) may have entered NROTC or USNA commissioning programs as long ago as 1989. Not only is the officer 'pipeline' lengthy, it also involves many stages and career experiences, including job and ship assignments, duty stations, voluntary retention decisions, job performance evaluations and promotions. Estimates find that only a small percentage of an entering officer cohort (as low as 10 percent) ultimately will stay in the military long enough and perform well enough to attain the rank of O-6 (Bowman and Mehay, 2004).

A.   PURPOSE OF THE STUDY

The goal of the study is to assess the career success of Hispanics in the U.S. Navy officer corps. The study conducts a comparative analysis of the position and performance of Hispanics across the four service branches. The study uses standard indicators of personnel performance and position, including retention at various career points (such as at MSR and post-MSR) and career success as measured by promotion. The study also compares the occupational distribution of Hispanic and White officers within the Navy and within the other services and analyzes the contribution of this factor in explaining advancement and retention.

The study applies statistical techniques to analyze various indicators of officer career success and to compare the relative success of Hispanic and non-Hispanic officers. The study uses multivariate non-linear estimating models to analyze the effects of Hispanic ethnicity on officer retention and promotion within each service. The study also examines the differences in the effect of ethnicity on retention and promotion across the services.

The multivariate models control for a number of other determinants of retention and promotion. This includes commissioning source, citizenship, marital status, dependents, and occupational assignment. When these controls are included in the estimating models, the estimated effects of Hispanic background captures the direct effect of ethnicity. In some cases, however, Hispanic background is also correlated with other explanatory variables, such as non-citizenship and commissioning source. When this correlation is present, the estimated effects of these variables represent an indirect effect of Hispanic ethnicity on the career outcome. When these control variables are omitted from a multivariate regression, the coefficient of Hispanic background absorbs their effects and yields both the direct and indirect effects of demographic background. The study examines both the indirect and direct effects of ethnicity.

The goal of the analysis is to inform decision-makers on potential policies that would increase diversity in the Navy officer corps by expanding the market for Hispanic officers and increasing their career success. These policies would have the ultimate

objective of increasing the presence of Hispanics in the leadership grades of the Navy officer corps.

B.   ORGANIZATION

This study is organized into four sections. Section II provides background information on the Hispanic population and their representation in the military. Section III presents a review of prior studies on officer retention and promotion. Section IV explains the data used in this study, presents preliminary descriptive analyses of the data, and discusses the methodology of the study. Section V presents the results of the multivariate analyses of retention and promotion. Section VI summarizes the results of the study and presents the conclusions and recommendations.

II.   LITERATURE REVIEW

A.   PRIOR STUDIES OF HISPANIC MILITARY OFFICERS

This section reviews prior studies of officer career progression across the military services. We first examine studies that analyze retention or promotion in all four services, and which focus on issues of diversity. The Military Leadership Diversity Commission (2010b; 2010c) tabulated retention and promotion of officers in all four services. The retention analysis covered officers who served between 2000 and 2008. The Commission constructs synthetic cohorts constructed from annual snapshots, rather than longitudinally following specific entry cohorts. Cumulative continuation rates are calculated based on the percent of officers who served in year *t* who are still serving in year *t+1*. They find that cumulative continuation rates are generally higher for Hispanics than for other groups, and those differences in continuation rates between Hispanics and Whites increase as years of service (YOS) increase. The exception is the Navy where continuation rates are similar across demographic groups. The MLDC also tabulated promotion rate differences across race and ethnic groups and relied on data provided directly by the individual services. The data covered various years between 2007 and 2010. The analysis focused on line officers (called 'tactical' officers in the DoD occupational categories) to control for promotion differences across skills and compared the promotion rates for Hispanic officers to the overall rate. The results indicate that raw O-4 promotion rates for Hispanics were slightly (1–3 points) below the overall rate. Differences in promotion rates to O-5 and O-6, however, were much larger: 7–12 points lower in the Navy, USMC, and Air Force. These percentage point differences translated into differences of 10 percent and higher.

There are several aspects of these findings that should be kept in mind when interpreting these results. First, the tabulations do not control for other factors that independently may affect promotion and that may also be correlated with race or ethnicity. Second, the study did not test whether the raw differences were statistically significant. Finally, it is not known how the promotion rates were calculated. An example

is whether they represented cohort rates or simply the reported results of promotion boards at each grade.

The MLDC (2010a) also explored the issue of why minorities tend to have lower representation in senior leadership positions in all four services. They point out that, within each service, senior (flag) officers were more likely to be drawn from combat-related ('tactical/operational') career fields, but that, historically, minorities were less likely to be assigned to those career fields. For example, in 2006, 80 percent of Army generals (O-7 and above) came from Combat Arms fields, whereas only 15 percent came from Combat Service Support, and only 5 percent from Combat Support. Among new Army officers who entered in 2006, however, 56 percent of Whites were in Combat Arms, whereas only 49 percent of Hispanics and 34 percent of African Americans were in Combat Arms (Lim et al., 2009).

The MLDC focused on the services' occupational assignment procedures in explaining why minorities were less likely to be assigned to 'tactical/operational' occupations. The assignment process presents three possible explanations of why minorities were less likely to enter tactical occupations: (1) they prefer non-tactical/operational fields; (2) their weaker performance as cadets or midshipmen in their commissioning programs (ROTC, Academy, OCS) makes them less likely to receive their first choice of occupations; or (3) they graduate from programs (e.g., OCS versus Academy) that receive fewer slots in combat/tactical fields (MLDC, 2010a).[1] Lim et al. (2009) examined Army branch assignment data for male ROTC cadets and concluded that minority cadets' preferences were the most important factor in explaining why they were more likely to serve in non-combat arms branches compared to White males. The MLDC corroborated this finding using 2009 data from the Air Force.

Two prior Rand Corporation studies analyzed the effect of minority background on officer career progression in the military. The first study by Hosek et al. (2001) analyzed data on five officer cohorts who entered the military in 1977, 1980, 1983, 1987, and 1991. They analyzed retention and promotion rates for O-1 through O-6 for officers

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[1] Another factor is that new officers initially may enter tactical fields but fail to complete training or later transfer to a different field.

in 'non-professional' occupations using regression analysis to control for other factors that may affect promotion, such as occupational assignment. They broke demographic groups into Whites, Blacks, and 'other minorities' (which included Hispanics). For 'other minority' males they found that retention was similar to that of White men, but that O-4 promotion rates were about 8 points below those of Whites

The second Rand study on minority and female officers by Asch, Miller, and Malchiodi (2012) updated the Hosek et al. (2001) study with data on more recent officer cohorts. The study focused on officer career progression for all services through the grade of O-6. They used DMDC data which contained longitudinal information on officers by month or quarter between 1988 and 2010. The study analyzed retention and promotion milestones, each conditional on attaining the previous pay grade or retention point.

The authors created three-year windows in which individuals were promotion-eligible and a promotion occurred if the next highest grade was attained during these windows. The authors defined retention as staying until at least the first month of the relevant promotion window. For example, retention as an O-3 included all officers in an entry cohort who achieved O-3 and who stayed in service at least until the first month of the promotion-eligibility window for O-4 for that cohort. Figure 1 shows the promotion and retention career milestones (Asch et al., 2012).

Figure 1.   Retention and Promotion Career Milestones

Table 1 shows the results of the estimated differences in the probabilities of achieving each career milestone, conditional on achieving the previous milestone, for male officers by race and ethnicity. For Hispanic men, the study found slightly lower promotion in the early career and no difference in retention up to promotion to O-3. Retention, however, for Hispanic males to O-3 was 2.4 points higher than for White males, whereas the promotion rate to O-4 was 1.9 points lower. Given promotion to O-4, however, retention as an O-4 was 1.9 points higher for Hispanic men. Hispanic males also were less likely to be promoted to O-5 (by 4.6 percent points) but more likely to stay given promotion (by 2.7 percent points). Hispanics also were 7.7 percent points less likely to be promoted to O-6. The results indicated that Hispanic male officers were less likely to be promoted, but were more likely to stay given promotion, relative to White men.

Table 1.　　　Percentage-Point Differences in Promotion and Retention Rates for Male Officers (from Asch, Miller, & Malchiodi, 2012)

Milestone	Percentage of White Male Officers Retained/ Promoted	Percentage Point Difference: Minority Male Officers – White Male Officers		
		Black Males	Hispanic Males	Other Minority Males
Promotion				
O1 to O2	98.5	−1.1***	−0.5***	−0.1
O2 to O3	91.2	−1.2***	−0.4	0.1
O3 to O4	76.0	−2.6***	−1.9**	−0.4
O4 to O5	74.6	−4.3***	−4.6***	−3.8***
O5 to O6	46.9	−2.5	−7.7***	−4.1*
Retention as				
O1	99.8	0.1***	0.0	0.0
O2	99.3	0.0	−0.1	0.0
O3	70.1	4.8***	2.4***	5.4***
O4	87.9	1.7***	1.9**	4.4***
O5	81.4	2.5**	2.7	3.0**

NOTE: *** = statistically significant from zero at the 1 percent level; ** = statistically significant from zero at the 5 percent level; * = statistically significant from zero at the 10 percent level.

A summary of the promotion effects is shown in Table 2. Within a given cohort, there were no differences in the probability that White and Hispanic males attained O-4. While Hispanics had lower probabilities of promotion at each grade up to O-4, this was

offset by their higher retention. Among O-4s, Hispanic males were less likely to attain O-6 than White males. In this case, lower promotion rates were not offset by higher retention rates. The pattern was somewhat different for Hispanic women who had both lower promotion and lower retention rates than males and, thus, were less likely to attain O-4 than males. Also, Hispanic women who reached O-4 were less likely to attain O-6 than White males.

Table 2.　　　Likelihood of an Entry Cohort Reaching Promotion and Retention (from Asch, Miller, & Malchiodi, 2012)

	Percent of Entering Cohort	
	O-1 to O-4 Promotions	O-4 to O-6 Promotions
Male officers		
White	45.4	23.6
Black	47.2***	19.5***
Hispanic	45.9	20.1
Other	48.4***	21.0
Female officers		
White	30.8***	18.8***
Black	45.3	15.6***
Hispanic	36.4***	23.1
Other	37.2***	26.8
*** = statistically significant from White male officers at the 1 percent level; ** = statistically significant from White male officers at the 5 percent level; * = statistically significant from White male officers at the 10 percent level.		

B.　　PRIOR STUDIES OF RETENTION AND PROMOTION OF HISPANIC NAVY OFFICERS

A series of studies by the Center for Naval Analyses (CNA) examined the determinants of Navy officer career progression (Koopman, 1995; Parcell, 2003; Monroe & Cymrot, 2004; Kraus & Parcell, 2013). The studies focused on different aspects of pre-

commissioning background (e.g., college major, commissioning program) and career experiences (e.g., lateral transfer) of officers.

Koopman (1995) analyzed Surface Warfare Officers (SWO) in year groups 1976–1990 focusing on promotion rates to O-3 (at 51 months-of-service) and O-4 (at 132 months-of-service). The results of the multivariate regression models indicated that promotion rates were identical between Hispanic and White SWO officers. The results, however, found that Hispanics were less likely to survive 51 months from entry (covering the initial obligation) but have the same survival rate as Whites to 132 months-of-service.

Parcell (2003) extended the Koopman (1995) study by adding data on later cohorts and analyzing three of the largest Unrestricted Line (URL) communities: Surface Warfare (SWO), Submarine (SUB), and Aviation. Parcell (2003) analyzed the probabilities of promotion to grades O-3 through O-6, conditional on survival to each promotion window and the probability of achieving command at sea. The longitudinal data covered accessions (year groups) from 1976 through 1996 and followed newly commissioned officers until separation or 2002 (the end of the data collection). The study examined numerous determinants of promotion, including college institutional characteristics, commissioning program, the individual's college grades (GPA) and college major, and demographic characteristics. We report the results for Hispanics, which during this period represented only 4 percent of SWOs, 3 percent of Aviators, and 2 percent of SUB officers.

For SWOs and aviators the study found no differences between Hispanics and White officers in all promotion outcomes (O-3 through O-6) or in the probability of achieving command at sea. For submarine officers the study found Hispanics were less likely to be promoted to O-3, but found no differences in promotion to any of the other grades. These results were not affected when the retention and promotion models were estimated via bivariate probit techniques, which accounted for potential self-selection in the promotion outcomes due to voluntary stay/leave decisions prior to the promotion point.

Monroe and Cymrot (2004) analyze year groups 1975–1992 to model the promotion of Navy Staff and Restricted Line (RL) officers. The focus of the study was on

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promotion rates in Staff or RL communities of officers who accessed into these communities via lateral transfer from a URL community. The question they examined was whether officers who had achieved a warfare qualification in a URL community then transferred to a Staff or RL community were more likely to be promoted than officers who accessed directly into Staff or RL. The study found that Hispanics in each cohort were more likely to stay and promote to O-4 and O-5 than Whites. After conditioning on retention to the O-4 and O-5 career points, however, they found no differences between Hispanics and Whites in promotion to O-4 and O-5. The positive career effects (to O-4) for Hispanics were due to their higher retention rates rather than due to higher promotion rates among stayers.

The most recent CNA study on Navy officers by Kraus and Parcell (2013) analyzed the retention of SWO and Aviation officers and focused on the experiences of women and minorities. They track officers who enter in 1990–2003 until 2012, or separation. For the SWO community, the authors defined retention between year three and year nine, which is the earliest career point when officers are eligible to be reviewed for "up-or-out" promotion to O-4. Their retention measure captured retention in the SWO community, rather than in the Navy. Leavers included those who transfer from the SWO community to another community as well as those who resigned from the Navy. This definition of retention is particularly useful for community managers who must maintain manning levels by community. Based on this retention definition, however, SWO retention rates were lower than more traditional retention rates which were based solely on resignations from the Navy.

Among SWOs, the authors found that the unadjusted retention rate for Hispanics was 4.9 percent points higher than for Whites (.348 versus .299). In the logit regression models, however, the regression-adjusted Hispanic-White difference in retention was not statistically significant, for either males or females. The lack of significance of the direct effect of Hispanic background may have been due to several of the explanatory variables being correlated with group membership. For example, the authors include the military-civilian pay differential as an explanatory variable and find it had a significant overall positive retention effect. The average military-civilian pay differential for Hispanics was nearly twice that of Whites, which indicates that civilian labor market conditions were

considerably weaker for Hispanics. Thus, unadjusted retention rates for Hispanics tended to be biased upward because they fail to account for their higher cost of leaving.

Most of the studies cited to this point are considered descriptive rather than causal because none were derived from a structural model derived from an economic theory of behavior. The ACOL (Annualized Cost of Leaving) model is a behavioral model of retention that is grounded in economic theory and has been widely applied in explaining and forecasting the reenlistment behavior of enlisted personnel. The ACOL model assumes that the decision-maker evaluates military and civilian pay streams (from leaving or staying) over future time horizons and makes stay-leave decisions on the basis of the present discounted value of the pay difference. Any military pay policies which increase military pay over the selected horizon (e.g., as the introduction of a retention bonus), all else equal, tend to increase the cost of leaving and, thus, retention.[2]

Mackin, Darling, and Hasan (2002) applied the ACOL model to assess the impact of military pay and bonuses on Navy officer retention. In particular, they were interested in assessing the impact on retention of the Surface Warfare Officer Continuation Pay (SWOCIP). They used panel data on 10,949 Navy Surface Warfare officers (non-nuclear) who made voluntary retention decisions between 1979 and 2000.[3] The study analyzed voluntary retention decisions made between the expiration of MSR and 15 years-of-service (YOS). The panel probit model allowed the authors to track officers over time and to use individual-level fixed effects to control for heterogeneity in officer tastes and changes in tastes over time for officers who make repeated decisions to remain on active duty.

The study estimated a pay elasticity of 0.75 at the MSR point, which indicated that a 10 percent increase in military pay at that point (e.g., due to SWOCIP) increased the retention rate by 7.5 percent. Given the size of the SWOCIP at that time the authors estimated that the bonus increased retention at MSR by about 15 percent, which helped the Navy meet its retention goals. Relevant to our study, the authors analyzed the effect

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[2]The model is based on utility maximization, and the ACOL value must exceed the net distaste for the military lifestyle for the individual to choose the stay option.

[3] Nakada and Boyle (1996) apply the ACOL model to Navy officers in nuclear fields.

of non-Whites versus Whites rather than identifying non-Whites by race or ethnicity. They found that non-White officers were less likely to stay than Whites. The authors also found that the higher unemployment rates at the time of the retention decision was associated with higher retention.

Mackin, Darling, and Hasan offer several innovations in modeling officer retention. It was one of the few studies to analyze the retention decision within the structure of the ACOL decision-making model. Second, it used panel probit and fixed effects estimation techniques to account for individual heterogeneity. Finally, it estimated the causal effect of changes in military and civilian pay components on officer retention.

Table 3 summarizes the five studies of Navy officers' career outcomes, while Table 4 summarizes the studies that focus on all services' officers. Both tables cite the data and methodology in each study as well as the main results with respect to Hispanic officers.

Table 3. Summary of Prior Studies on Career Outcomes of Hispanic
Navy Officers

DATA AND METHODS	Koopman (2008)	Parcell. (2003)	Monroe & Cymrot (2004)	Kraus & Parcell (2013)	Mackin et al. (2002)
Period	1976–1990	1976–1996	1975–1992		
Type of Data	Cohort, Longitudinal	Cohort, Longitudinal	Cohort, Longitudinal	Cohort, Longitudinal	Panel data (unbalanced)
Officer Population	SWO	SWO, SUB, Aviation	Staff, RL	SWO, Aviation	SWO
Method	Regression	Regression; Bivariate Probit	Regression	Regression	Panel probit; individual-level fixed effects
Other Features	College background	College background		Military-Civilian Pay	ACOL theoretical model
Retention Effect	4 YOS (-) 11 YOS (n.s.)		Cohort effects: O-4 (+) O-5 (+)		Between MSR and 15 YOS (- for non-Whites)
Promotion Effect	O-3 and O-4 (n.s.)	Grades O-3 – O-6 (n.s.)		9 YOS (n.s.)	
Joint Retention + Promotion			O-4, O-5 (n.s.)		
Other Outcomes	Command at sea (n.s.)				
n.s. = not statistically significant					

Table 4.   Summary of Prior Studies on Career Outcomes for Military
Officers—All Four Services

DATA AND METHODS	Hosek et al. (2001)	Asch et al. (2013)	MLDC (2010)
Period	1977–1991	1988-2010	2000-2010
Type of Data	Cohort, Longitudinal	Cohort, Longitudinal	Synthetic Cohort
Officer Population	All services	All Services	All services
Method	Regression	Regression; Bivariate Probit	Tabulations
Other Features		Conditional retention and promotion	
Retention Effect	Other minorities to O-4 (-)	To O-4, O-5, O-6 (+)	Cumulative Continuation (+), except USN
Promotion Effect	Other minorities,O-4 promotion (-)	To O-4, O-5, O-6 (-)	O-4 promotion (-) O-5, O-6 promotion(-)
n.s. = not statistically significant			

The literature review finds a wide variation in estimates of the effects of ethnicity on officer retention and promotion. Some of the variation can be attributed to differences in the time period covered by the data or whether the data are cross-sectional or longitudinal. Some variation is due to differences in modeling methodology, with some studies analyzing unadjusted continuation and promotion rates and some estimating adjusted rates derived from multivariate models. Among studies with multivariate models, some relied on single-equation models of retention or promotion, whereas others used modeling techniques to adjust for self-selection of officers in the voluntary retention decision. At least one study applied the ACOL behavioral model to specify and estimate a structural model of officer retention. There were also basic differences in how retention or promotion outcomes were defined and measured. These differences make comparisons across studies difficult and weaken any conclusions that can be drawn from the literature.

III. DATA AND DESCRIPTIVE STATISTICS

The Defense Manpower Data Center (DMDC) provided the data used in this analysis. The data set includes all officers commissioned between fiscal years (FY) 1999 and 2003. Information on numerous demographic and service-related characteristics is included for each individual upon commissioning, and an annual update is provided through FY 2013, or until the individual separated from the service. The initial data set included 86,330 observations.

A. DATA DESCRIPTION

Demographic variables include a unique identifier for each officer, gender, marital status, age, race/ethnicity, and number of dependents. Professional variables include service branch, education, source of commissioning, pay grade, commissioning date, date of current rank, months in current grade, Military Occupational Specialty (MOS), basic active service date, and separation date. Some variables can change over times, such as marital status, education, and number of dependents, and are recorded at different career points.

Several restrictions are imposed on the data. Specifically, we dropped Coast Guard officers and those who enter above the grade of O-1. The latter restriction excludes mostly officers who are in professional occupations, such as medical, legal, and religious career fields. To sharpen the focus on commissioned officers, we also deleted Navy Limited Duty Officers (LDO) and Warrant Officers. The final data set consists of 63,560 observations.

B. VARIABLE DESCRIPTIONS

1. Officer Performance Measures

We analyze officer retention at two career points: just after expiration of the Minimum Service Requirement (MSR) and until 10 YOS. For the purpose of the study, officers who completed at least six years-of-service are assumed to have stayed beyond their MSR. The second retention model analyzes whether an officer stays in the military until reaching promotion zone to the grade of O-4, which is at 10 YOS. We also analyze

the probability of promotion to grade O-4, which is considered an "up-or-out" decision. For the purpose of the study, officers are given a one-year promotion window after 10 YOS.

2.   Independent Variables

Demographic variables used in the retention and promotion models include gender, age, marital status, number of dependents, race, and ethnicity. To capture changes over time in marital status and number of dependents these variables are measured at entry, at six YOS (MSR), and at 10 YOS. The race/ethnicity variable is divided into five categories: White, Black, Hispanic, Asian, Other race (Unknown race refers to individuals who do not identify race).

Professional variables used in the models include service, education, source of commissioning, and prior enlisted service. Education is divided into three categories: college degree, postgraduate degree, and unknown education. Source of commissioning variable is divided into five categories: Academy, ROTC, OCS/OTS, Direct, and Other commissioning source. Separate variables for academy graduates are also created for each service: USMA for the Army, USNA for the Navy, and USAFA for the Air Force. Occupational categories for all four services are defined, based on DoD occupational codes at the time of entry. The cross-service occupational categories used in this analysis are: Tactical, Intelligence, Engineering, Professionals, Health Care, Administration, Supply and Other.

All of the multivariate models include cohort dummy variables for the five cohorts who entered between FY99 and FY03. The cohort dummies are included to capture unobserved factors that may affect retention and promotion outcomes differently for each cohort. MSR retention decisions may vary because each cohort may be affected by different civilian employment conditions when they reach the decision point. The 2002 and 2003 cohorts, for example, completed their service obligations at the beginning of great recession that began in 2008. Early cohorts may have been affected by the beginning of the GWOT in 2003. In the promotion models the cohort dummies will reflect differences in promotion opportunities by year group due to policy changes or

fluctuation manning levels (e.g., due to force drawdowns or expansions).   All independent variable names and their descriptions are shown in Table 5.

Table 5.   Independent Variables Description

Variable Name	Description
Demographic Variables	
Female	=1 if female; else 0
Male	=1 if male; else 0
Married	=1 if married at time of entry; else 0
Not Married	=1 if not married at time of entry; else 0
Married at MSR	=1 if not married in year 6; else 0
Not Married at MSR	=1 if married in year 6; else 0
Age at entry	Age at time of entry
Dependents	Number of dependents at time of entry
Dependents at MSR	Number of dependents in year 6
Naturalized	=1 if naturalized U.S. citizen at entry; else 0
White	=1 if White; else 0
Black	=1 if Black; else 0
Hispanic	=1 if Hispanic; else 0
Asian	=1 if Asian; else 0
Other race	=1 if other race or unknown; else 0
Professional Variables	
USMA	=1 if commissioning source is West Point; else 0
USAFA	=1 if commissioning source is Air Force Academy; else 0
USNA	=1 if commissioning source is Naval Academy; else 0
ROTC	=1 if commissioning source is ROTC; else 0
Academy	=1 if commissioning source is a service academy; else 0
OCS_OTS	=1 if commissioning source is OCS/OTS; else 0
Direct	=1 if commissioning source is direct appointment; else 0
Other Commissioning	=1 if commissioning source is other or unknown; else 0
College Degree	=1 if college degree at time of entry; else 0
Postgrad Degree	=1 if Master's Degree or above at entry; else 0
Other Education	=1 if education at time of entry is other, or unknown; else 0
Tactical	=1 DoD occupation is Tactical at entry; else 0
Intelligence	=1 DoD occupation is Intelligence at entry; else 0
Engineering	=1 DoD occupation is Engineering at entry; else 0
Professionals	=1 DoD occupation is Professional at entry; else 0
Health Care	=1 DoD occupation is Health Care at entry; else 0
Administration	=1 DoD occupation is Administration at entry; else 0
Supply	=1 DoD occupation is Supply at entry; else 0
Other	=1 DoD occupation is Trainee or Other at entry; else 0

3.   Descriptive Statistics

Table 6 shows the sample means for the variables used in the multivariate retention and promotion models. Hispanics comprise 5.6 percent of officers. The mean

MSR retention rate is 70.9 percent. Only 53 percent of newly commissioned officers, however, stay in the military for 10 YOS, and only 43 percent of those officers are promoted to O-4, or 81 percent of officers who stay 10 years. Mean values for dependent variables are very similar across services. The Navy has somewhat higher retention rates, while the Army has lower retention rates than the DoD average. For those who stay 10 years, O-4 promotion rates are highest in the Army (90 percent), and lowest in the Marine Corps (67 percent).

Female officers comprise about one-fifth of the total force. At entry most officers, 75 percent, are not married. Whites are the biggest racial group comprising 76 percent of the total force, followed by Blacks comprising 8.9 percent, and Hispanics at 5.6 percent.

ROTC is the largest commissioning program producing 40 percent of all officers, followed by the Academies which produce 21 percent, OCS/OTS with 26 percent, and direct/other commissions at 29 percent. Academy graduates are 29 percent of new Navy officers, whereas ROTC graduates are 58 percent of new Army officers. The Air Force has the highest percent of officers commissioned through OTS comprising about 29 percent, although the biggest commissioning source for the Army is ROTC comprising 54 percent of its officers.

Table 6.   Mean Characteristics of Officers, by Service

Dependent Variables	DoD	Army	Air Force	Marine Corps	Navy
Retention at MSR	0.7092	0.6110	0.7720	0.7270	0.7395
Retention 10 YOS	0.7521	0.7869	0.7502	0.7579	0.7173
Promotion	0.8127	0.9006	0.8071	0.6670	0.7720
Demographic Variables					
Female	0.1909	0.2001	0.2116	0.0907	0.1842
Male	0.8091	0.7999	0.7884	0.9093	0.8158
Married	0.2513	0.2448	0.2994	0.2892	0.1813
Not Married	0.7487	0.7552	0.7006	0.7108	0.8187
Married at MSR	0.4306	0.4377	0.4878	0.4475	0.3383
Not Married at MSR	0.5694	0.5623	0.5122	0.5525	0.6617
Age at Entry	24.9029	24.7517	25.0964	24.8791	24.8423
Dependents	0.1497	0.1018	0.1499	0.1343	0.2182
No Dependents	0.8503	0.8982	0.8501	0.8657	0.7818
Dependents MSR	0.2182	0.1945	0.2318	0.1891	0.2388
No Dependents MSR	0.7818	0.8055	0.7682	0.8109	0.7612

Naturalized	0.0164	0.0000	0.0283	0.0206	0.0193
White	0.7623	0.7342	0.7816	0.8182	0.7525
Black	0.0888	0.1274	0.0740	0.0577	0.0711
Hispanic	0.0562	0.0568	0.0251	0.0682	0.0940
Asian	0.0405	0.0498	0.0266	0.0326	0.0505
Other Race	0.0522	0.0318	0.0927	0.0232	0.0318
Professional Variables					
Academy	0.2140	0.2275	0.1969	0.1473	0.2401
ROTC	0.4032	0.5412	0.4573	0.0789	0.2652
OCS_OTS	0.2940	0.1760	0.2990	0.6269	0.3236
Direct	0.0312	0.0098	0.0235	0.0007	0.0784
Other Commissioning	0.0576	0.0454	0.0228	0.1441	0.0916
College Degree	0.6937	0.8248	0.6850	0.9190	0.4683
Postgrad Degree	0.0411	0.0136	0.0204	0.0082	0.1145
Other Education	0.2652	0.1616	0.2946	0.0727	0.4172
Tactical	0.1751	0.4759	0.0643	0.0142	0.0059
Intelligence	0.0384	0.0501	0.0453	0.0002	0.0271
Engineering	0.1268	0.2175	0.1434	0.0000	0.0333
Professionals	0.0115	0.0000	0.0295	0.0101	0.0018
Health Care	0.0720	0.1149	0.0363	0.0000	0.0915
Administration	0.0767	0.0559	0.0717	0.0081	0.1323
Supply	0.0687	0.0851	0.0809	0.0036	0.0533
Other	0.4307	0.0006	0.5286	0.9638	0.6549
Prior Enlisted	0.1239	0.0000	0.1548	0.2015	0.2099
No. of Observations					
MSR Retention Sample	63,560	20,049	22,032	5,336	16,143
10-YOS Retention*	45,076	12,250	17,009	3,879	11,938
Promotion Sample**	35,560	9,982	13,336	3,092	9,150
* Retention rates for those who stay past MSR ** Promotion rates for those who past 10 years					

T-tests of differences in the performance measures between Hispanic and non-Hispanic officers are shown in Table 7. Hispanics have higher MSR and 10-year retention than non-Hispanics, although in some cases retention differences are not statistically significant. Differences in promotion rates to O-4 are not statistically significant, except for Navy, where Hispanics promote at a slightly higher rate than non-Hispanics. While these comparisons are useful to identify overall patterns, they do not control for other factors that can also affect retention and promotion. The next section specifies and estimates the multivariate retention and promotion models.

Table 7.   T-tests of Differences in Retention and Promotion for Hispanic and White Non-Hispanic Officers

MSR Retention			
	Hispanic	Non-Hispanic	t-value
All	0.7080	0.7287	-2.6456***
Army	0.6652	0.6077	-3.8628***
Air Force	0.7559	0.7724	0.9160
Marine Corps	0.7995	0.7216	-3.2189***
Navy	0.7495	0.7385	-0.9313
10 YOS Retention			
	Hispanic	Non-Hispanic	t-value
All	0.7284	0.7536	2.8900***
Army	0.8005	0.6564	-0.9427
Air Force	0.7321	0.7507	0.8671
Marine Corps	0.8076	0.7539-	-2.0558**
Navy	0.6588	0.7235	4.6120***
Promotion O-4			
	Hispanic	Non-Hispanic	t-value
All	0.7750	0.7750	-0.0245
Army	0.8658	0.8700	0.3033
Air Force	0.7515	0.7727	0.9005
Marine Corps	0.6611	0.6319	-0.9061
Navy	0.7488	0.7199	-1.7658*
*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent			

IV.   ANALYSIS AND DISCUSSION OF RESULTS

A.   METHODOLOGY

The study uses multivariate non-linear estimating techniques to analyze the effects of Hispanic ethnicity on officer retention and promotion. Because the dependent variables are binary, the models are estimated via probit techniques. The probit coefficients can be used to estimate marginal effects, which are the effects of one-unit changes in each explanatory variable on the probability of retention or promotion. The next section presents the marginal effects from the probit model results.

B.   POOLED MODELS, ALL SERVICES

The results of the three probit models for the pooled all-service sample are presented in Table 8. In column (1), Hispanic officers have MSR retention rates that are 2 points above those of White officers within an entering cohort. This effect is not large, representing only a 2.9 percent difference in retention, estimated at the mean (=.0207/.7095). In column (2), the effect of Hispanic background on 10-year retention (among MSR stayers) is not statistically significant. In column (3), the estimated effect of Hispanic background on promotion is negative but is not significant at standard levels of confidence (p=.11).

The results of the demographic variables show that female officers have lower retention rates at both career points and they have lower promotion rates than men. The magnitudes of the retention differences are large. The MSR retention rate for women is 11.7 points below that of men (about 16.5 percent) and 10-year retention is 8.9 points (11.8 percent) lower. Also, the female-male promotion gap is -3.7 points (about 4.8 percent).

Among other results, married officers have higher retention at both career points and have higher promotion rates compared to single officers. Also of interest is that Black officers have significantly higher retention than Whites at both career milestones but lower promotion rates to O-4. It should be noted that these estimates represent within-cohort effects as the models include cohort dummy variables.

Academy graduates have higher MSR retention than OCS graduates but reveal no difference in 10-year retention or O-4 promotion. ROTC graduates are less likely to stay beyond MSR but also reveal no differences in 10-year retention. Interestingly, both Academy and ROTC graduates are significantly less likely to be promoted to O-4.

We can compare the all-service results in our study in Table 8 with those in Asch et al. (2012). Asch et al. found retention in grade O-3 (for six years) was 2.4 percentage points lower for Hispanic males than for White males, and that promotion rates for Hispanic males were 1.9 points lower. Similarly, Blacks and females had lower O-4 promotion rates than White males. Whereas women, however, had much lower retention rates, Blacks were more likely to stay in the military.

By way of comparison, we find that retention at MSR is about 2 points higher for Hispanics, but that there is no difference in retention to 10 YOS. Moreover, we find no differences in O-4 promotion outcomes for Hispanics as compared to Whites. On the other hand, for women we confirm that overall O-4 promotion rates are lower than for men, and that women have lower retention at both career milestones (six and 10 YOS). Blacks also have lower promotion rates but higher retention than Whites.

Although our study covers more recent cohorts (who entered the military between 1999 and 2003) than in the Asch et al. study, we cannot conclusively argue that our study represents important recent changes in the patterns of career progression of Hispanic officers (e.g., Hispanic officers are now equally likely to be promoted to O-4 across the military). There are too many differences in the data and methodology of the two studies to warrant such conclusions. For example, both studies use different definitions of retention, different variable definitions and different model specifications (Asch et al. did not include cohort dummies). Moreover, the all-service effects are simply the average effects across the individual services, each of which is governed by different career management systems and retention and promotion standards. Thus, we place more emphasis on the cross-service comparisons, which are presented in the analyses in the next section.

Table 8.   Marginal Effects for the Probit Models, DoD Sample

Variables	(1) MSR Retention	(2) Retention 10 YOS (MSR Stayers)	(3) Promotion to O-4 (Promotion-Eligible)
Female	-0.1172***	-0.0890***	-0.0372***
	(0.0053)	(0.0064)	(0.0071)
Married	0.0587***		
	(0.0039)		
Married at MSR		0.1693***	
		(0.0046)	
Married 10YOS			0.0890***
			(0.0054)
Age at Entry	0.0178***	0.0168***	-0.0080***
	(0.0007)	(0.0008)	(0.0077)
Naturalized	-0.0082	0.0090	-0.0098
	(0.0160)	(0.0161)	(0.0165)
Black	0.0512***	0.0508***	-0.0157**
	(0.0061)	(0.0068)	(0.0082)
Hispanic	0.0207**	0.0065	-0.0156
	(0.0080)	(0.0087)	(0.0100)
Asian	0.0164*	0.0203*	0.0046
	(0.0091)	(0.0102)	(0.0119)
Other Race	0.0043	0.0143	-0.0099
	(0.0085)	(0.0091)	(0.0104)
Academy	0.0306***	-0.0293***	-0.0202**
	(0.0063)	(0.0073)	(0.0081)
ROTC	-0.0132**	-0.0038	-0.0464***
	(0.0057)	(0.0062)	(0.0068)
Direct	0.0069	0.0480***	0.0504***
	(0.0121)	(0.0135)	(0.0123)
Other Commissioning	0.0379**	0.0158	-0.0068*
	(0.0086)	(0.0096)	(0.0054)
Postgrad Education	0.0023	0.0608***	0.0224**
	(0.0106)	(0.0097)	(0.0102)
Other Education	-0.0023	0.0201***	0.00045
	(0.0047)	(0.0049)	(0.0098)
Intelligence	-0.1535***	-0.0695***	0.0091
	(0.0091)	(0.0100)	(0.0098)
Engineering	-0.1459***	-0.0876***	0.0020

	(0.0067)	(0.0072)	(0.0072)
Professionals	-0.1852***	-0.0715***	0.0112
	(0.0175)	(0.0175)	(0.0169)
Health Care	0.1302***	-0.0348***	-0.0510***
	(0.0104)	(0.0115)	(0.0119)
Administration	-0.1636***	-0.1163***	0.0093
	(0.0092)	(0.0103)	(0.0119)
Supply	-0.1815***	-0.0802***	0.0127
	(0.0078)	(0.0085)	(0.0118)
Other	0.5034***	0.0510***	-0.0312
	(0.0061)	(0.0080)	(0.0098)
Cohort_FY00	-0.0496***	0.0191***	0.0334***
	(0.0063)	(0.0062)	(0.0073)
Cohort_FY01	-0.0502***	0.0478***	-0.0059
	(0.0065)	(0.0059)	(0.0075)
Cohort_FY02	-0.1143***	0.0739***	-0.0476***
	(0.0065)	(0.0057)	(0.0077)
Cohort_FY03	-0.0798***	0.0709***	-0.2842***
	(0.0065)	(0.0057)	(0.0089)
Army	-0.1476***	0.0974***	0.1607***
	(0.0059)	(0.0055)	(0.0054)
Air Force	0.0530***	0.0546***	0.0591***
	(0.0053)	(0.0054)	(0.0057)
Marine Corps	-0.0636***	0.0551***	-0.1033***
	(0.0088)	(0.0074)	(0.0105)
Observations	62,823	44, 570	35,560
Mean	0.7095	0.7532	0.7743
Likelihood Ratio Chi^2	10527.79(28)	4335.59(28)	3918.57(28)
Pseudo R^2	0.1390	0.0870	0.1042
Standard errors in parentheses.			
*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent			

C.   MSR RETENTION MODEL BY SERVICE

Table 9 shows the marginal effects from the MSR retention models estimated separately for all four services. The results show that in the Army and Marine Corps Hispanic officers have significantly higher MSR retention rates (compared to Whites), and comparable MSR retention in the Air Force. Hispanics are 6.6 percentage points (11 percent) more likely to stay beyond MSR in the Army and 7.1 percentage points (10 percent) more likely to stay in the USMC. In the Navy, by contrast, Hispanics have lower

MSR retention rates, by 2.3 points. However, not only is the difference in Navy MSR retention small in size, it is not significant at conventionally accepted confidence levels (.95 or .99).

For Black officers, the positive all-service MSR retention effect is driven solely by a large positive retention effect in the Army. In the other three branches, retention differences between Blacks and Whites are not significant. For women, the negative all-service MSR retention effect is based on lower retention rates across all four branches.

Table 9.   Marginal Effects for the MSR Retention Model, by Service

Variables	Army	Air Force	Marine Corps	Navy
Female	-0.0872***	-0.1194***	-0.0749***	-0.1423***
	(0.0103)	(0.0078)	(0.0235)	(0.0105)
Married	0.0487**	0.0296***	0.0821***	0.0866***
	(0.0079)	(0.0059)	(0.0131)	(0.0074)
Age at Entry	0.0287***	0.0139***	0.0235***	0.0144***
	(0.0016)	(0.0010)	(0.0028)	(0.0014)
Naturalized		-0.0158	0.0456	0.0693***
		(0.0176)	(0.0436)	(0.0231)
Black	0.1041***	0.0034	0.0254	0.0076
	(0.0112)	(0.0104)	(0.0262)	(0.0137)
Hispanic	0.0669***	-0.0027	0.0718***	-0.0239*
	(0.0158)	(0.0178)	(0.0226)	(0.0133)
Asian	0.0594***	0.0079	0.0144	-0.0226
	(0.0163)	(0.0168)	(0.0354)	(0.0169)
Other Race	0.0976***	-0.0182*	0.0154	-0.0251
	(0.0264)	(0.0099)	(0.0401)	(0.0214)
Academy	-0.0414***	0.0385***	0.1060***	0.0280**
	(0.0163)	(0.0095)	(0.0163)	(0.0134)
ROTC	-0.0192***	-0.0178**	-0.0103	-0.0835**
	(0.0136)	(0.0083)	(0.0256)	(0.0129)
Direct	0.0057	0.0817***	0.0264	0.0071
	(0.0439)	(0.0141)	(0.2107)	(0.0165)
Other Commissioning	-0.0218	-0.0074	0.0392**	0.0149
	(0.0264)	(0.0186)	(0.0179)	(0.0140)
Postgrad Education	0.0180	-0.0422**	-0.1501*	0.0082
	(0.0358)	(0.0220)	(0.0862)	(0.0142)
Other Education	0.0622***	0.0010	-0.1064***	-0.0276***

	(0.0138)	(0.0069)	(0.0292)	(0.0107)
Intelligence	-0.0782***	-0.2905***	-0.2376***	-0.1575***
	(0.0146)	(0.0171)	(0.0304)	(0.0219)
Engineering	-0.0825***	-0.2460***	-0.2138***	0.2195***
	(0.0106)	(0.0111)	(0.0270)	(0.0238)
Professionals		-0.2249***	0.3225***	-0.2759***
		(0.0204)	(0.0823)	(0.0428)
Health Care	-0.0462***	-0.3378***		-0.1920***
	(0.0170)	(0.0238)		(0.0209)
Administration	0.0155	-0.3090***	-0.1812***	-0.2390***
	(0.0160)	(0.0149)	(0.0292)	(0.0278)
Supply	-0.1250***	-0.2950***	-0.1718***	-0.2094***
	(0.0139)	(0.0139)	(0.0211)	(0.0185)
Other	-0.6574**	0.5032***	0.6100***	-0.4168***
	(0.0050)	(0.0120)	(0.0191)	(0.0108)
Cohort_FY00	-0.0476***	-0.0064	-0.1179***	-0.04232***
	(0.0151)	(0.0100)	(0.0222)	(0.0123)
Cohort_FY01	-0.0060***	-0.0003	-0.1085***	-0.0611***
	(0.0136)	(0.0100)	(0.0222)	(0.0126)
Cohort_FY02	-0.0465***	-0.1590***	-0.0686***	-0.0914***
	(0.0150)	(0.0114)	(0.0228)	(0.0129)
Cohort_FY03	-0.0192	-0.1060***	-0.0579***	-0.1100***
	(0.0150)	(0.0111)	(0.0229)	(0.0134)
Observations	20,042	21,371	5,311	16,096
Mean MSR Retention	0.6110	0.7743	0.7277	0.7399
Likelihood Ratio Chi^2	4187.68 (23)	3572.39(25)	925.02(24)	2744.47(25)
Pseudo R^2	0.1563	0.1565	0.1487	0.1488

Standard errors in parentheses.
*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent

C.   10-YEAR RETENTION MODEL

This section discusses the results of estimating retention to 10 YOS, which represents decisions of those who elect to remain beyond MSR and also elect to stay for the O-4 promotion review at 10 YOS. The results are displayed in Table 10.

In Table 10, Hispanic background has no effect on 10-year retention except in the Air Force where 10-year retention is lower for Hispanics. Black officers are more likely

to stay 10 years in the Army and the Navy. Women are less likely to stay to the O-4 promotion board in all four service branches.

Table 10.   Probit Marginal Effects for the 10-Year Retention Model, MSR Stayers, by Service

Variables	Army	Air Force	Marine Corps	Navy
Female	-0.0855***	-0.1126***	-0.0754***	-0.0580***
	(0.0115)	(0.0100)	(0.0289)	(0.0131)
Married at MSR	0.1605***	0.1793***	0.1706***	0.1520***
	(0.0083)	(0.0080)	(0.0156)	(0.0088)
Age at Entry	0.0130***	0.0138***	0.0219***	0.0278***
	(0.0014)	(0.0012)	(0.0030)	(0.0018)
Naturalized		0.0082	0.0433	0.0587*
		(0.0207)	(0.0486)	(0.0311)
Black	0.0774***	0.0108	0.0348	0.0357**
	(0.0092)	(0.0126)	(0.0282)	(0.0164)
Hispanic	-0.0128	-0.0381*	0.0411	0.0014
	(0.0147)	(0.0231)	(0.0252)	(0.0149)
Asian	0.0374**	-0.0065	0.0234	0.0005
	(0.0144)	(0.0214)	(0.0252)	(0.0205)
Other Race	0.0689***	-0.0070	-0.0108	0.0460*
	(0.0168)	(0.0122)	(0.0465)	(0.0229)
Academy	-0.1456***	0.0121	-0.0549***	-0.0113
	(0.0193)	(0.0121)	(0.0221)	(0.0162)
ROTC	-0.0424***	-0.0114	-0.0218	-0.0036
	(0.0132)	(0.0101)	(0.0292)	(0.0143)
Direct	0.0032	0.0271		0.0793***
	(0.0403)	(0.0141)		(0.0213)
Other Commissioning	-0.0412	-0.0703***	0.0105	0.0479***
	(0.0287)	(0.0268)	(0.0303)	(0.0155)
Postgrad Education	0.0515	-0.0086	-0.0237	0.0490***
	(0.0309)	(0.0245)	(0.0993)	(0.0126)
Other Education	0.0082	0.0082	-0.0052***	-0.0150
	(0.0128)	(0.0088)	(0.0303)	(0.0126)
Intelligence	-0.0142	-0.1916***	-0.1166***	0.0562***
	(0.0139)	(0.0185)	(0.0348)	(0.0201)
Engineering	-0.0292***	-0.2274***	-0.0623**	0.0298
	(0.0095)	(0.0114)	(0.0289)	(0.0234)
Professionals	-0.3793	-0.1552***	-0.4680***	0.1048**

	(0.3850)	(0.0213)	(0.0922)	(0.0385)
Health Care	0.0280*	-0.1556***		-0.0397
	(0.0146)	(0.0270)		(0.0259)
Administration	0.0373***	-0.2831***	-0.0640**	-0.0037
	(0.0132)	(0.0164)	(0.0309)	(0.0283)
Supply	0.0033	-0.2203***	-0.0388*	0.0009
	(0.0133)	(0.0149)	(0.0218)	(0.0184)
Other	0.1826**	0.0386***	0.1146***	0.0014
	(0.0057)	(0.0134)	(0.0293)	(0.0135)
Cohort_FY00	0.0279**	0.0343***	0.0374*	-0.0140
	(0.0126)	(0.0100)	(0.0200)	(0.0132)
Cohort_FY01	0.0636***	0.0682***	0.0301	0.0140
	(0.0116)	(0.0096)	(0.0202)	(0.0131)
Cohort_FY02	0.0642***	0.0927***	0.0677***	0.0819***
	(0.0116)	(0.0096)	(0.0197)	(0.0121)
Cohort_FY03	0.0672***	0.0722***	0.0542***	0.0938***
	(0.0115)	(0.0100)	(0.0199)	(0.0122)
Observations	12,247	16,548	3,864	11,910
Mean 10-year retention	0.7869	0.7529	0.7585	0.7172
Likelihood Ratio Chi^2	1431.32 (24)	2185.43(25)	383.75(23)	1355.08(25)
Pseudo R^2	0.1128	0.1181	0.0898	0.0955

Standard errors in parentheses.
*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent

D.   PROMOTION MODEL

Table 11 shows the marginal effects of the promotion model estimates separately by service. The sample for the model includes only those who stay for 10 years and are promotion-eligible. No Hispanic promotion differences are detected in any of the four service branches. We find, however, promotion gaps for other demogrphaic groups. Women are less likely to be promoted to O-4 in all of the services, with the execption of the Navy. The greatest promotion gap is in the Marine Corps where promotion rates for women are about 12 percent below those of men. Married officers are more likely to be promoted to O-4 in all four services, all else equal. Blacks are significantly less likely to be promoted (by 6 percent) only in the Air Force.

Table 11.   Probit Marginal Effects for the Promotion Model,
Promotion-Eligibles, by Service

Variables	Army	Air Force	Marine Corps	Navy
Female	-0.0315***	-0.0422***	-0.0776*	-0.0068
	(0.0104)	(0.0115)	(0.0418)	(0.0148)
Married at MSR	0.0450***	0.0841***	0.1081***	0.1218***
	(0.0081)	(0.0093)	(0.0223)	(0.0108)
Age at Entry	-0.0022***	-0.0103***	-0.0047	-0.0093***
	(0.0011)	(0.0013)	(0.0039)	(0.0018)
Naturalized		-0.0407*	0.0137	0.0241
		(0.0241)	(0.0655)	(0.0323)
Black	-0.0061	-0.0388***	-0.0393	-0.0116
	(0.0098)	(0.0157)	(0.0413)	(0.0184)
Hispanic	-0.0086	-0.0029	-0.0156	-0.0078
	(0.0144)	(0.0232)	(0.0364)	(0.0181)
Asian	0.0012**	0.0076	0.0009	-0.0244
	(0.0153)	(0.0242)	(0.0577)	(0.0243)
Other Race	0.0321*	-0.0250*	-0.0076	0.1049
	(0.0153)	(0.0141)	(0.0679)	(0.0272)
Academy	-0.0217	0.0590***	-0.1523***	-0.0484**
	(0.0149)	(0.0126)	(0.0330)	(0.0199)
ROTC	0.0077	-0.0690***	-0.0316	-0.0257
	(0.0107)	(0.0112)	(0.0440)	(0.0171)
Direct	0.0737*	0.0209		0.0143
	(0.0165)	(0.0241)		(0.0249)
Other Commissioning	0.0248	-0.0253***	-0.0493	-0.0107
	(0.0165)	(0.0283)	(0.0305)	(0.0177)
Postgrad Education	0.0382	0.0307	0.0937	0.0375**
	(0.0225)	(0.0234)	(0.1222)	(0.0171)
Other Education	-0.0354***	-0.0455***	0.0531	0.0191
	(0.0118)	(0.0097)	(0.0413)	(0.0146)
Intelligence	0.0231*	-0.0464***	-0.0719	0.0707***
	(0.0121)	(0.0187)	(0.0459)	(0.0204)
Engineering	-0.0027	-0.0374***	-0.0017	0.1059***
	(0.0093)	(0.0115)	(0.0369)	(0.0205)
Professionals		-0.0166	0.0832	0.0618
		(0.0206)	(0.1586)	(0.0385)

Health Care	-0.0622***	-0.1998***		0.0758***
	(0.0167)	(0.0273)		(0.0213)
Administration	0.0273**	-0.0326**	-0.0708*	0.1125***
	(0.0119)	(0.0167)	(0.0401)	(0.0272)
Supply	0.0265**	-0.0460***	-0.0099	0.0828***
	(0.0111)	(0.0148)	(0.0293)	(0.0179)
Other	-0.7861***	-0.0562***	-0.0951*	0.0427***
	(0.0380)	(0.0158)	(0.0541)	(0.0154)
Cohort_FY00	-0.0063	0.0845***	0.0484	0.0083
	(0.0138)	(0.0110)	(0.0306)	(0.0160)
Cohort_FY01	-0.0383***	0.0270***	-0.0097	-0.0089
	(0.0145)	(0.0120)	(0.0300)	(0.0163)
Cohort_FY02	-0.0505***	0.0010	-0.0515*	-0.0798***
	(0.0147)	(0.0123)	(0.0304)	(0.0168)
Cohort_FY03	-0.0991***	-0.0307***	-0.6444***	-0.2981***
	(0.0160)	(0.0153)	(0.0194)	(0.0181)
Observations	9,978	13,020	3,083	9,125
Mean promotion rate	0.8697	0.7704	0.6345	0.7228
Likelihood Ratio Chi^2	409.30 (23)	2006.67(25)	930.76(23)	792.10(25)
Pseudo R^2	0.0530	0.1430	0.2299	0.0735
Standard errors in parentheses. *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent				

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V.   ANALYSIS OF USMC OFFICER DATA

In this section we estimate performance models separately for Marine officers. We analyze Marine officers separately for several reasons. First, the analyses in section IV may have omitted variables that are important to retention or promotion and that also may be correlated with ethnicity. For example, prior research has inked officers' job performance to their educational backgrounds (Bowman and Mehay, 2002; Koopman, 1995). Examples of background attributes include the quality of undergraduate education (college selectivity), academic performance (college GPA, order of merit), college major (technical versus non-technical), and aptitude (SAT score), among others. When these variables are omitted from the performance models, the estimated coefficient of the ethnicity indicator will capture the indirect effects of the omitted variables as well as the direct effects of ethnicity.

No information on educational background was available in the DMDC data files. The Marine Corps Total Force Data Warehouse (TFDW), however, provides extensive background information on Marine officers, including information on undergraduate college majors, college grade point average (GPA), college quality, and aptitude scores (General Classification Test).[4] TFDW data allows us to assess the effects of the variables that are omitted in the models in section IV and to gauge the possible biases those estimates. We also obtained fitness report scores on officers and used these scores as measures of officer performance to supplement the retention and promotion measures.

Fitness reports are written by a reporting senior (RS) and a reviewing officer (RO) both of whom evaluate an individual's performance. The scores are compared to the scores given by the same RS or RO to other individuals in the same pay grade. The relative values (RV) are recorded for each individual and are used in this study. Two different scores are recorded. The first measure captures fitness reports written at the point of retention or promotion, whereas the second measure captures the cumulative score for all reports written prior to a point in time.

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[4]For a description of TFDW data on officers see Garza (2014) and Bowling et al. (2008).

The relative value scores at time of processing are captured by the variable *AvgRV_Proc*, while the cumulative relative value scores are captured by *AvgRV_Cum*. In the regression model, we use only scores on fitness reports written by the Reporting Senior (RS). The averages of all scores written prior to the six- and 10-year mark are used in the OLS regression model. The RS scores are reported on an 80–100 point scale.

The USMC data set contains 7,880 observations on Marine Corps officers commissioned between 1999 and 2004. The officers were observed every year until the end of 2014, or until separation. We estimate performance models for MSR retention (six YOS), 10-year retention, and O-4 promotion. In addition, we estimate models of the determinants of cumulative fitness report scores.

Table 12, column 2, shows the sample means for the performance variables. Among all entrants, the MSR retention rate is .73. The 10-year retention rate is .54 for new entrants but is .74 among those who stay past MSR. Among promotion-eligible officers, the O-4 promotion rate is .69. Table 12 also displays *t*-tests of differences in the mean values of career outcomes between Hispanic and non-Hispanic Marine officers. Table 12 shows that Hispanics' MSR retention rates are three points (points) (4 percent) above non-Hispanics. 10-year retention for Hispanics is 5.7 points above non-Hispanics, and 10-year retention among MSR stayers is 4.6 points higher for Hispanics. There are no differences in O-4 promotion rates between Hispanic and non-Hispanics.

Table 12.   T-tests of Differences in Retention and Promotion

Career outcomes	N	All	Hispanic	Non-Hispanic	t-stat	Significance. Level
MSR Retention	7807	0.733	0.762	0.731	-1.50	*
10 YOS Retention (entry cohort)	7807	0.547	0.602	0.543	-2.54	***
10 YOS Retention (MSR Stayers only)	5728	0.746	0.789	0.743	-2.02	**
Promote O-4 (entry cohort)	7880	0.568	0.573	0.567	-0.22	-
Promote O-4 (10 year Stayers)	5801	0.6983	0.6718	0.7003	1.18	-
Significance Level: * = .10 (1.282), ** = .05 (1.646), *** = .01 (2.330)						

Table 13 provides definitions of the pre-commissioning educational background variables. The name of the officer's college was matched with selectivity data from Barron's *Profiles of American Colleges*. Barron's selectivity rankings are based on a nine-value scale from "Most Competitive" to "Non-Competitive." We grouped the top five of the nine competitive categories into a binary variable called *TopColl*. The selectivity in Barron's scale is based in part on such factors as a school's freshman acceptance rate and the average SAT score for those admitted. We created a binary variable (*STEM*) to capture college majors in Science, Technology, Engineering, or Mathematics. The General Classification Test (GCT) is a measure of aptitude similar to the AFQT test.

Table 13.   Pre-Entry Educational Variable Descriptions and Values

Name	Variable Description	Value
GCT	General Classification Test Score	67 – 156
SAT	SAT Score	690 – 1600
Coll_GPA	College GPA	1 – 4.0
TopColl	Attended a College classified as: Most, Highly+, Highly, Very Competitive+, or Very Competitive	= 1 if yes; 0 if No
PriCollege	Attended a Private College	= 1 if yes; 0 if No
Academy	Commissioned through Military Academy	= 1 if yes; 0 if No
MECEP	Commissioned through MECEP	= 1 if yes; 0 if No
NROTC	Commissioned through NROTC	= 1 if yes; 0 if No
OCC	Commissioned through OCC	= 1 if yes; 0 if No
MCP	Commissioned through MCP	= 1 if yes; 0 if No
PLC	Commissioned through PLC	= 1 if yes; 0 if No
STEM	STEM Bachelor's Degree	= 1 if yes; 0 if No

Table 14 shows summary statistics for the pre-entry variables for the full sample and separately for the Hispanic and non-Hispanic sub-samples. The mean GCT score is slightly less than 125, while the mean SAT score is 1198. Average college GPA is 2.93, and 54 percent attended a top-rated college. Less than one-third of the officers attended a

private university or earned a STEM degree, and the OCC program was the largest accession source.

Table 14 also displays t-tests for differences in college background. The t-tests show that attendance at highly selective colleges by Hispanics is 10 points (18 percent) lower than for non-Hispanics. T-tests also indicate that aptitude variables—*SAT*, C*oll_GPA*, and *GCT*—are somewhat lower for Hispanics. Average SAT scores are 44 points lower, college GPAs are 2.6 percent lower, and GCT scores are 3 percent lower among Hispanics versus non-Hispanics. Among the accession sources, the t-tests show that Hispanics are less likely to enter via (by 5.7 points) NROTC but are far more likely to enter via the MECEP program (by 11 points) or via OCC.

Table 14.   T-tests of Differences in Educational Background

Variable	N	All	Hispanic	Non-Hispanic	t-stat	Significance. Level
SAT	3671	1198.0000	1156.3350	1200.3240	4.4254	***
Coll_GPA	5661	2.9365	2.8652	2.9413	2.7957	***
TopColl	7880	0.5459	0.4524	0.5524	4.4119	***
PriCollege	7158	0.2947	0.3122	0.2935	-0.8486	-
STEM	7823	0.2339	0.2148	0.2353	1.0554	-
GCT	7819	124.9276	121.4414	125.1719	8.7583	***
Academy	7886	0.1116	0.1010	0.1123	0.7916	-
NROTC	7886	0.1410	0.0874	0.1448	3.6197	***
OCC	7886	0.3805	0.3456	0.3830	1.6882	**
PLC	7886	0.1165	0.1049	0.1174	0.8545	-
MECEP	7886	0.1510	0.2544	0.1438	-6.7933	***
Significance Level: * = .10 (1.282), ** = .05 (1.646), *** = .01 (2.330)						

Table 15 displays parameter estimates from the probit models for six-year and 10-year retention (for MSR stayers) and O-4 promotion. The six-year retention model is displayed in columns 1–2, the 10-year retention model in columns 3–4, and the promotion model in columns 5–6. All models also include variables for physical fitness

test (PFT) scores, rifle qualification scores, awards, combat deployments, and dummy variables for cohort year.[5]

It is likely that fitness report scores influence individuals' voluntary retention decisions. Moreover, promotion boards consider fitness report scores in promotion decisions. Thus, fitness report scores may be important determinants of retention and promotion and we include officers' cumulative RS fitness report scores (*AvgRV_Cum_10*) as an explanatory variable in the 10-year retention and promotion models. The measure captures cumulative scores on fitness reports written up to the relevant point of retention or promotion, in this case at 10 YOS.

Table 15.   Marginal Effects from Retention and Promotion Probit
Models for Marine Corps Officers

Six-Year Retention Model		10-Year Retention Model		O-4 Promotion Model	
Variables	*M.E.*	*Variables*	*M.E.*	*Variables*	*M.E.*
Female	-0.0554**	Female	-0.0043	Female	-0.0157
	(0.0274)		(0.0238)		(0.0270)
Hispanic	0.0590**	Hispanic	0.0473**	Hispanic	0.0179
	(0.0270)		(0.0221)		(0.0256)
Age	0.0203***	Age	0.0144***	Age	0.0014
	(0.0036)		(0.0031)		(0.0032)
Naturalized	0.0868*	Naturalized	0.1023***	Naturalized	-0.0017
	(0.0458)		(0.0331)		(0.0439)
GCT	-0.0023***	GCT	-0.0003	GCT	-0.0007
	(0.0008)		(0.0007)		(0.0008)
TopColl	-0.0529***	TopColl	-0.0527***	TopColl	-0.0252*
	(0.0155)		(0.0129)		(0.0143)
PriCollege	-0.0467***	PriCollege	-0.0256*	PriCollege	-0.0339**
	(0.0166)		(0.0142)		(0.0154)
Academy	0.1673***	Academy	-0.0178	Academy	-0.1067***
	(0.0188)		(0.0209)		(0.0253)
NROTC	0.0654***	NROTC	-0.0091	NROTC	-0.0317
	(0.0207)		(0.0200)		(0.0236)
MECEP	0.1450***	MECEP	0.1316***	MECEP	-0.0837***
	(0.0207)		(0.0166)		(0.0250)
PLC	0.0664***	PLC	0.0356**	PLC	0.0001
	(0.0219)		(0.0175)		(0.0212)

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[5] Sample sizes in Table 15 do not match those in Table 12 due to missing observations for some of the variables included in each model.

STEM	0.0162	STEM	0.0215	STEM	-0.0071
	(0.0176)		(0.0138)		(0.0155)
tbs_overall_gpa	0.0003	tbs_overall_gpa	0.0023	tbs_overall_gpa	0.0088***
	(0.0024)		(0.0021)		(0.0023)
css_mos	0.0160	css_mos	0.0889***	css_mos	0.0514***
	(0.0161)		(0.0149)		(0.0178)
avgrd_mos	0.0719***	avgrd_mos	0.1276***	avgrd_mos	0.0859***
	(0.0252)		(0.0171)		(0.0254)
		AvgRV_Cum_10	0.0111***	AvgRV_Cum_10	0.0317***
			(0.0022)		(0.0024)
Observations	4,490	Observations	5,084	Observations	5,144
Mean retention rate	0.678	Mean retention rate	0.751	Mean promotion rate	0.705
M.E. = Marginal Effects; Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10. All models also include variables for physical fitness test (PFT) scores, rifle qualification scores, awards, combat deployments, and dummies for cohort year.					

Columns 1–2 of Table 15 find that Hispanic officers are more likely to stay beyond MSR than non-Hispanics by 5.9 points (9 percent). Table 15 also shows that the retention rate of naturalized citizens is 8.7 points (13 percent) above that of non-naturalized citizens. Females are less likely to stay than males by 5.5 points (9 percent). Among the education variables, officers with higher GCT scores, or who graduated from a highly selective college or from a private college, are more likely to leave at MSR..

Columns 3-4 of Table 15 display the results for the 10-year retention model (for MSR stayers). Hispanics have retention rates 4.7 points (6 percent) above their counterparts, and naturalized citizens have retention rates 10.2 points (13 percent) above others. Graduates of top-rated colleges are more likely to leave at the 10-year mark, while MECEP graduates are more likely to stay. Interestingly, there is no gender difference in 10-year retention. The cumulative fitness report score (*AvgRV_Cum*) is a significant predictor of 10 YOS retention, with a one-unit increase in the score (on a base of 20 points) increasing the retention rate by 1.1 points.

The O-4 promotion model results are displayed in columns 5–6 of Table 15. The results indicate that promotion rates are comparable between Hispanics and non-Hispanics. Similarly, there is no gender-based promotion gap.

The pre-entry variables indicate that USNA graduates are 10.6 points less likely to be promoted, and those from *MECEP* are 8.3 points less likely to be promoted. College

GPA has a small positive effect on promotion, whereas *TopColl* and *PriCollege* both have significant negative effects on O-4 promotion. Finally, a one-unit increase in the cumulative fitness report score (*AvgRV_CUM*) is associated with an increase in promotion rates of 3.1 points.

We further explore the effect of demographic background on fitness report scores. The t-tests in Table 16 reveal significant differences in the RS fitness report scores, with Hispanics receiving significantly lower scores on both measures. The *AvgRV_Proc* scores are .62 points (3.1 percent) lower for Hispanics, and RS cumulative scores are lower by .43 points (2.1 percent).

Table 16.　　T-tests of Differences in Fitness Report Scores

Variable	N	Full	Hispanic	Non-Hispanic	t-stat	Significance Level
AvgRV_Proc	7,639	92.16	91.57	92.20	2.85	***
AvgRV_Cum	7,691	91.04	90.63	91.06	2.69	**
* = .10 (1.282), ** = .05 (1.646), *** = .01 (2.330)						

Table 17 presents the RS cumulative fitness report model estimates. Because the dependent variable is continuous rather than binary the model is estimated via OLS techniques. Table 17 finds that the small, but significant, ethnic-based differences in fitness report scores in Table 16 are statistically insignificant when other factors are controlled in a multivariate model.

Table 17 does find, however, that female officers have significantly higher cumulative fitness report scores than men even after controlling for commissioning source, occupational field and other attributes. *MECEP* graduates score higher by 0.49 points (2.4 percent) and officers with higher TBS class ranking (overall GPA) receive higher fitness report scores by 0.34 points (or 1.7 percent).

Table 17.   RS Cumulative Fitness Report Score OLS Model

VARIABLES	M.E.	VARIABLES	M.E.
Female	0.5486***	PLC	-0.4341***
	(0.1938)		(0.1399)
Hispanic	-0.1992	STEM	-0.0843
	(0.1721)		(0.1010)
Age	-0.0738***	tbs_overall_gpa	0.3451***
	(0.0206)		(0.0149)
Naturalized	-0.7458***	css_mos	0.2352*
	(0.2714)		(0.1316)
GCT	-0.0147***	avgrd_mos	0.8425***
	(0.0055)		(0.2041)
TopColl	-0.0351	law_mos	0.4584
	(0.0949)		(0.2913)
PriCollege	0.1156	air_mos	-0.5075***
	(0.1006)		(0.1284)
Academy	0.2372		
	(0.1602)		
NROTC	0.2074	Observations	3,879
	(0.1573)	R-squared	0.227
MECEP	0.4925***		
	(0.1405)		
All models also include variables for physical fitness test (PFT) scores, rifle qualification scores, awards, combat deployments, and dummies for cohort year.			

The results show that an officer's educational background affects performance and that Hispanic Marines in this sample enter the military with lower aptitude scores and academic variables. In addition, they are less likely to graduate from a top-rated college. Some of these factors affect career performance, generally negatively. Specifically, higher GCT scores and graduation from a top-rated or private college are negatively associated with six-year retention, and graduation from a top-rated or private college are negatively associated with 10-year retention and with promotion to O-4.

It appears that the direct estimated effects of Hispanic background tend to be biased in models that omit educational background attributes. This is particularly important in instances where the effect of Hispanic background on a specific variable, such as promotion or fitness report score, tends to be negative. If the omitted variables (e.g., educational background) also are negatively correlated with Hispanic background,

the estimated effect of Hispanic background will be biased toward zero (i.e., understated). Thus, the finding of no promotion effect or no effect of fitness report score for the Hispanic group may be affected by omitted variable bias.

Although there are significant differences in model specifications, variable definitions, and data coverage, we can make some comparisons between the results for Marine officers derived from DMDC data versus from TFDW data. It should be kept in mind that the comparison group to Hispanics is different in the two data sets. In the models based on DMDC data the comparison group is non-Hispanic Whites whereas in the TFDW analyses the comparison group is all non-Hispanics. The DMDC results indicate that, compared to Whites, Hispanics have higher MSR retention but no difference in 10-year retention or promotion rates. When using TDFW data, the results find that both MSR retention and 10-year retention are both higher for Hispanics, but find no differences in promotion rates.

For women the results also diverge between the two data sources. Both analyses find that MSR retention is lower for women. The analysis based on DMDC data, however, finds both lower 10-YOS retention and lower promotion rates for women, whereas the analysis using the TFDW data finds no differences between men and women in the 10-year retention and promotion outcomes.

VI. SUMMARY AND CONCLUSIONS

A. SUMMARY

The underrepresentation of Hispanics in the officer corps presents an ongoing challenge to DoD policymakers in maintaining diversity in the leadership ranks. The goal of this study is to assess the career progression of Hispanics in the Navy officer corps. This study analyzes officer retention at two career points: beyond the Minimum Service Requirement (MSR) and at 10 years-of-service (YOS). We also analyze the probability of promotion to grade O-4. Table 18 summarizes the results of the statistical analyses of officer retention and promotion.

The results of the probit models for the pooled all-service sample find that, within an entering cohort, Hispanic military officers have higher MSR retention rates than White non-Hispanic officers. This effect is not large, representing only a 3 percent difference in retention, which is driven by large positive effects in the Army and Marine Corps. By contrast, the effect of Hispanic background on 10-year retention and on O-4 promotion is not statistically significant. These effects, however, vary across the individual services. For example, in the Navy MSR retention for Hispanic officers is lower than in the Army and Marine Corps. Also, 10-year retention of Hispanics in the Air Force is lower than in the other services.

Table 18.   Estimated Percentage Point Differences in Career
Outcomes for Hispanic Officers

Career Outcomes	All Services (DMDC Data)	Army	Air Force	USMC	Navy	USMC (TFDW Data)
MSR Retention	+2.0	+6.6	N.S.	+7.1	-2.3[a]	+5.9
10 YOS Retention	N.S.	N.S.	-3.8	N.S.	N.S.	+4.7
O-4 Promotion	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Fitness Report Scores	--	--	--	--	--	-1.9
N.S.= Not significant [a]Significant at .10 level; all other percentage point differences are significant at either the .01 or .05 level						

Although differences in career outcomes among Hispanics are small or insignificant, differences for women or Blacks are larger and generally statistically significant. For example, we find that women have lower retention rates at both the MSR career point and at the 10-year point and that the magnitude of these retention gaps are relatively large. Also, women are less likely to be promoted to O-4. Black officers have significantly higher retention than Whites at both career milestones but experience lower promotion rates to O-4.

We also analyze career outcomes separately for Marine Corps officers using supplemental data from the Marine Total Force Data Warehouse (TFDW), which provides information on officers that is not available in DMDC data files. Examples of background attributes include the quality of undergraduate institution (college selectivity), undergraduate academic performance (college GPA), college major (technical versus non-technical), or aptitude (SAT scores), among others. One of our goals in using USMC data is to assess the effects of the variables that are omitted in this study's previous analyses and any potential possible biases in the earlier estimates.

Finally, we also obtained fitness report scores on Marine officers and used these scores as performance measures to supplement the analyses of retention and promotion.

The supplemental results for Marine officers based on TFDW data are summarized in the last column of Table A. In both data sets Hispanic Marines have higher MSR retention rates. However, unlike the DMDC data, the TFDW data shows that Hispanics have higher 10-year retention in the Marine Corps. Also, the last row of Table A indicates that Hispanics receive lower cumulative fitness report scores than non-Hispanic officers. Finally, supplemental analyses of the TFDW data finds that fitness report scores positively impact O-4 promotion rates.

The results suggest that the direct estimated effects of Hispanic background will tend to be biased in models that omit fitness report scores. Because fitness report scores are positively associated with O-4 promotion and Hispanics are observed to have lower cumulative fitness report scores, when fitness report scores are omitted from the promotion models, the estimated effect of Hispanic background will be biased toward zero (i.e., understated). Thus, the finding of no promotion effect for the Hispanic group may be affected by omitted variable bias.

In summary, it appears that Hispanic officers in the Navy are performing well compared to the other services. The sole exception is the lower retention of junior officers at the MSR point. However, the size of the MSR retention effect is small and is not significant at the conventionally accepted levels of .01 or .05. Nonetheless, this difference in MSR represents an outcome that could affect the career progression of Hispanic officers toward top leadership positions and thus warrants further investigation.

This conclusion, however, is subject to several important qualifications. First, due to lack of data, we do not model promotion to O-5 or O-6. In addition, modeling retention and promotion outcomes in single-equation models may be insufficient to capture the career progression of a given demographic group. For example, models of promotion to O-4 will be affected by selection bias because officers who stay to the O-4 promotion review point are self-selected. Hence, promotion models must account for selection bias. Also, both voluntary retention decisions as well as decisions by promotion boards are affected by job performance, as measured by fitness reports. A more complete analysis of

career progression for any group using administrative data requires multi-equation models that account for self-selection and for the intermediate effects of measured job performance.

It appears that the direct estimated effects of Hispanic background will be biased in models that omit fitness report scores. We find that fitness report scores are positively associated with both long-term retention and with O-4 promotion. This is particularly important because Hispanic background is negatively correlated with cumulative fitness report scores. Thus, when fitness report scores are omitted from retention and promotion models, the estimated effect of Hispanic background will be biased toward zero (i.e., understated). Thus, the finding of no promotion effect for the Hispanic group may be affected by omitted variable bias.

Another source of bias may arise due to the omission of important factors from the key models. The analysis of USMC data from the Total Force Data Warehouse found that measured aptitude and college background both can influence career outcomes and that omission of these variables in retention and promotion models also may lead to biased estimates of the effects of ethnicity or race.

B.   RECOMMENDATIONS

One of the principal findings of our data analysis was a lower MSR retention rate for junior Hispanic officers than for White non-Hispanic officers. We recommend that the Navy explore possible causes for the lower retention of junior Hispanic officers. Because the retention difference is small it may be difficult to pinpoint causes that would have a differential effect on one demographic group. [6] Nevertheless, it would be worthwhile to examine the issue further and to see whether the difference continues to exist in the most recent cohorts of officers.

We also find that female Navy officers (as well as women in the other services) have lower retention at MSR and at 10 years of service than men. The magnitude of the male-female retention gap tends to be large and warrants further examination.

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[6] Snodgrass (2014) outlines some possible policies and factors that may have affected recent officer retention problems in general in the Navy.

This study focused on retention and promotion measures, which represent outcomes that result from numerous career experiences, encompassing both officers' voluntary choices and service decisions. We also recommend that future research efforts acquire more in-depth and extensive data on the career experiences of officers and on their personal attributes when entering the Navy. This data should capture information on pre-commissioning factors such as educational background. The data should also capture in-service experiences that may provide greater insight into officers' voluntary retention decisions and promotion board selections. Within the Navy, for example, data is needed on service selection, skill qualification, lateral transfers, ship and unit assignments, deployments, graduate education and other billet and duty information (see Mehay, 2001).

Acquisition of improved data would enhance the specifications of models of career outcomes. In addition, such data would permit the application of multi-equation modeling techniques that could account for selection bias in promotion models and analyze the joint determination of various intermediate measures of performance, such as fitness report scores, and retention (see e.g. Bowman and Mehay, 2002).

Information on fitness report scores is particularly important as such scores can be used as indicators of officer job performance to supplement standard measures of retention and promotion. Standard studies of retention and promotion are used to assess whether Hispanics are less likely to reach leadership positions due either to lower retention or poorer promotion outcomes. Fitness report scores, however, are likely to affect voluntary retention decisions and are important factors in promotion board reviews.

The Navy's recent Talent Management initiative envisions using a broad set of milestone achievements as the basis for promotion eligibility for officers and eliminating officer management by year group (Mabus, 2015). This revised career management system means that the path to promotion and leadership positions will depend more on an officer's individual performance rather than on meeting the rigid requirements set out in a pre-designated career path. This revised system will depend heavily on detailed data on officer career milestones to track officers' career development to top leadership assignments.

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